

EIMERIA CHEVRIERI SP. NOV. (APICOMPLEXA, EIMERIIDAE) FROM APODEMUS CHEVRIERI (RODENTIA, MURIDAE)

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Abstract Fresh fecal samples from 31 *Apodemus chevrieri* M-Edwards 1868 were collected and examined for coccidian in 2006. The mice were collected in Taiping Town. Nine of the 31 (29%) specimens of mice contained two species of genus *Eimeria*. One of them is described as new species. Sporulated oocysts of *Eimeria chevrieri* sp. nov. were ellipsoidal, 21.2×16.3 ($22.2-19.7 \times 17.3-15.6$) μm , with ovoid sporocysts, 11.2×7.5 ($12.3-10.3 \times 8.3-6.8$) μm . The smooth oocysts wall had one layer around $1.0 \mu\text{m}$ thick. No micropyle and oocyst residuum were present, but 1-2 polar granules, sporocyst residuum, stieda body and sub-stieda body were present.

Key words *Apodemus chevrieri*, *Eimeria*, new species, China.

Introduction

Field mice of the genus *Apodemus* Kaup, 1829 are Palearctic murid rodents (family Muridae), and distribute from the British Islands to Japan (Nowak 1991). *Apodemus chevrieri* M-Edwards, 1868, is a nocturnal or crepuscular, small rodent mainly living on the Yunnan-Guizhou Plateau located in Southwestern China (Huang et al., 1995).

The species of *Eimeria* from wild rodents has not been extensively studied in China. Knowledge of the *Eimeria* species in the genus *Apodemus* comes mostly from European authors. Here we present a description of one new species of *Eimeria* originating from *Apodemus chevrieri* collected in Taiping Town, located in Kunming City, Yunnan Province, the People's Republic of China, and a redescription of *Eimeria hungaryensis* in this murid host.

1 Materials and Methods

Specimens of *Apodemus chevrieri* were collected in 2006 during faunistic research focused on the distribution of Taiping Town rodents. This locality is a fruit forest dominated by peach *Amgdalus persica*.

All hosts were live-trapped and killed within a few hours after capture. The intestinal tract was removed, and feces from the colon and cecum were placed in vials of 2.5% (w/v) potassium dichromate solution ($\text{K}_2\text{Cr}_2\text{O}_7$). Samples were processed for oocysts in the laboratory by separating fecal contents from intestinal tissue, filtering, incubating at room temperature, and examining by coverslip flotation. Oocysts were measured and photographed at Yunnan University in accordance with the guidelines of Duszynski and Wilber (1997) with Olympus BH-2. All measurements are in μm with the ranges in parentheses following the means.

2 Results

During the coprological examination of 31 *A. chevrieri*, we detected the presence of oocysts of genus *Eimeria* in 9 specimens. The morphological of sporulated oocysts revealed two species of *Eimeria* that are described and discussed below.

2.1 *Eimeria chevrieri* sp. nov. (Figs. 1-2, 4)

Sporulated oocysts are ellipsoidal, 21.2×16.3 ($22.2-19.7 \times 17.3-15.6$), shape index (SI = length/width) 1.30 (1.22-1.38). Oocyst wall is smooth, appearing as single-layered in light microscopy, colorless, around $1.0 \mu\text{m}$ thick. Micropyle and oocyst residuum are absent; 1-2 polar granule are present, irregularly elongated, $1.0-2.0 \mu\text{m}$ in diameter. Sporocysts are long ovoid, 11.2×7.5 ($12.3-10.3 \times 8.3-6.8$); SI 1.49 (1.43-1.61). Tiny stieda body and sub-stieda body are present; stieda body is lentil-like, $1.0 \times 0.3 \mu\text{m}$, sub-stieda body subglobular $2.5 \times 1.5 \mu\text{m}$. Sporocyst residuum is present, composed of small granules of various size, most of them about $0.7 \mu\text{m}$, scattered centrally between sporozoites. Sporozoites lie head-to-tail within the sporocyst. There is a clear refractile body at the broader end in each sporozoite, measuring around $3.0 \mu\text{m}$.

Type host. *Apodemus chevrieri* (M-Edwards), 1968 (Rodentia, Muridae).

Type locality. Taiping Town (25°24'N, 102°35'E; alt. 1894 m), Kunming City, Yunnan Province, China.

Prevalence. Found in 5 of 31 (16.1%) *A. chevrieri* (M-Edwards), 1968.

Site of infection. Unknown, oocysts discovered in feces.

Sporulation time. 4-5 days at 25°C.

Material deposited. Phototype of sporulated oocysts

are deposited in Department of Biology, Yunnan University No. 2006047. Symbiotype in Yunnan University Biological Specimen Museum No. 20060081 (Duszynski and Wilber, 1997).

Etymology. The specific name is derived from the trivial name of the host.

2.2 *Eimeria hungaryensis* Levine & Ivens, 1956 (Figs. 3, 5)

Sporulated oocysts are spherical or subspherical, 21.7×17.8 ($23.2-19.4 \times 18.3-15.6$); wall around 1.3, appears to be composed of one layer, light yellow-brown, with a scabrous surface; SI 1.21 (1.13-1.30); micropyle and oocyst residuum are absent; 1-2 polar granules are present. Sporocysts are long ovoid, 10.3×7.1 ($12.3-8.7 \times 8.3-6.5$); SI 1.45 (1.40-1.51). Stieda body are present, but sub-stieda bodies are

absent. Sporocyst residuum is composed of granules, either compact or dispersed, filling the large part of sporocyst. Sporozoites are sausage-shaped and generally not discernible.

Host. *Apodemus chevrieri* (M-Edwards), 1968 (Rodentia, Muridae).

Locality. Taiping Town (25°24' N, 102°35' E; alt. 1 894 m), Kunming City, Yunnan Province, China.

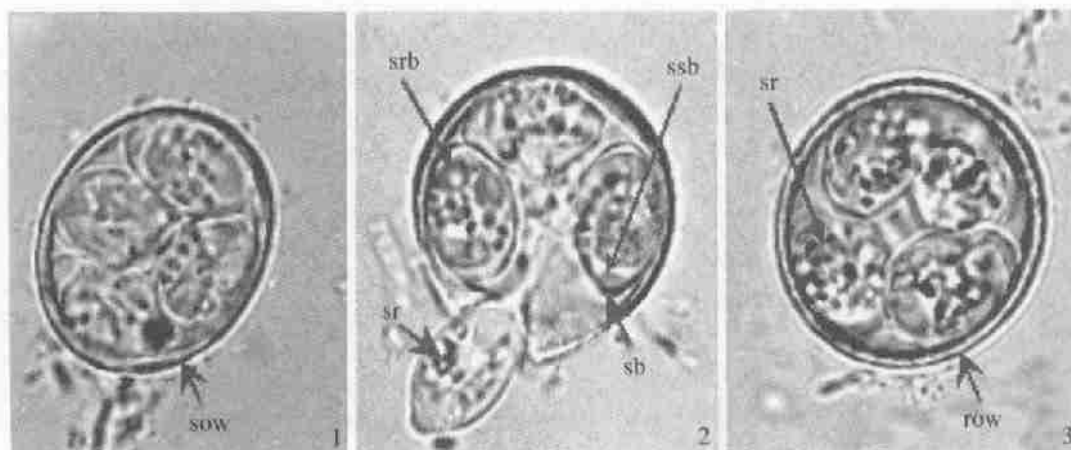
Prevalence. Found in 7 of 31 (23%) *A. chevrieri* (M-Edwards), 1968.

Site of infection. Unknown, oocysts recovered from feces.

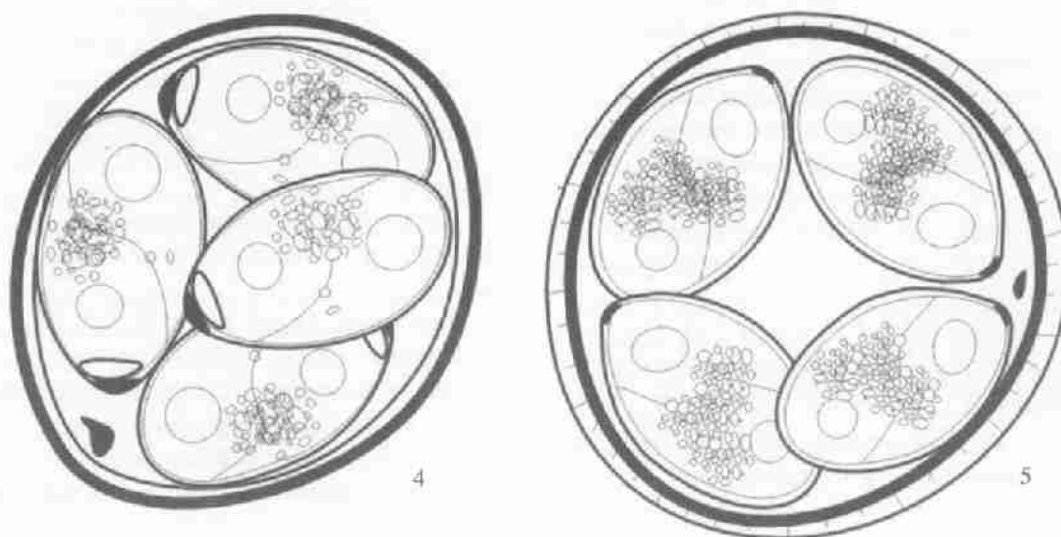
Sporulation time. 4-5 days at 25 °C.

3 Discussion

More than thirty species of *Eimeria* have so far been



Figs. 1-3. Micrographs of sporulated oocysts of *Eimeria* spp. discovered from the feces of *Apodemus chevrieri*. $\times 1200$. 1. *Eimeria chevrieri* sp. nov., showing the smooth oocyst wall (sow). 2. *Eimeria chevrieri* oocyst wall detached. Note Stieda body (sb), sub-stieda body (ssb), sporocyst residuum (sr), and sporozoite refractile body (srb). 3. *Eimeria hungaryensis* with rough oocyst wall (row) and dispersed sporocyst residuum (sr).



Figs. 4-5. Line drawings of sporulated oocysts of *Eimeria* spp. discovered from the feces of *Apodemus chevrieri*. 4. *Eimeria chevrieri* sp. nov. 5. *Eimeria hungaryensis* Levine & Ivens, 1956.

described from field mice (*Apodemus* spp.). Higgs and Nowell (1991) re-evaluated all species of *Eimeria* from rodents of the genus *Apodemus* and concluded that 21 named species may be valid. Hürkov á et al. (2005) found two new species of *Eimeria* from *Apodemus*

nystacinus. We compared the two observed species of *Eimeria* from *Apodemus chevrieri* with all 23 valid *Eimeria* parasites (Table 1), and found one of them to be different from all described species and therefore it is considered a new species.

Table 1. Summary of basic morphological data of named *Eimeria* spp. reported from *Apodemus*.

Species of coccidia	Oocysts					Sporocysts			
	Shape	Wall	Dimensions (mean)	Resi- ddum	Polar body	Dimensions	Resi- ddum	Stieda body	Reference
<i>Eimeria chevrieri</i> sp. nov.	Ellipsoidal	Smooth	21.2 ×16.3	No	Yes	11.2 ×7.5	Yes	Yes	This paper
<i>E. agrarii</i>	Spherical	Smooth	25.1 ×25.1	No	No	10.0 ×6.6	Yes	No	Musaev & Veisov , 1965
<i>E. alorani</i>	Ellipsoidal	Smooth	26.9 ×19.3	No	Yes	12.9 ×7.7	Yes	Yes	Hürkov á et al. , 2005
<i>E. apionodes</i>	Short piriform	Smooth	20.0 ×17.0	No	No	12.0 ×8.0	Yes	No	Pell édy , 1974
<i>E. apodemi</i>	Broadly ellipsoidal	Smooth	24.0 ×20.0	No	No	12.0 ×7.0	Yes	No	Pell édy , 1974
<i>E. argenteus</i>	Subspherical	Rough	22.5 ×19.3	No	Yes	12.7 ×7.3	Yes	Yes	Wash et al. , 1985
<i>E. badamlinica</i>	Spherical	Smooth	16.4 ×16.4	No	Yes	6.4 ×4.4	Yes	ND	Musaev & Veisov , 1965
<i>E. gandobica</i>	Ellipsoidal	Smooth	19.0 ×16.8	No	Yes	8.0 ×5.0	Yes	Yes	Musaev & Veisov , 1965
<i>E. gomurica</i>	Ellipsoidal	Smooth	26.9 ×20.5	Yes	No	11.9 ×8.1	Yes	No	Musaev & Veisov , 1965
<i>E. gumbaschica</i>	Spherical	Smooth	16.6 ×16.6	No	No	6.0 ×4.5	Yes	No	Musaev & Veisov , 1965
<i>E. hungaryensis</i>	Subspherical	Rough	20.0 ×18.0	No	No	15.0 ×9.0	Yes	Yes	Levine & Ivens , 1965
<i>E. inuyamensis</i>	Elongate-ellipsoidal	Rough	25.6 ×16.2	No	Yes	11.3 ×7.4	Yes	Yes	Wash et al. , 1985
<i>E. jeffinica</i>	Ellipsoidal	Rough	25.8 ×22.3	No	No	11.7 ×9.1	Yes	No	Musaev & Veisov , 1965
<i>E. kaunensis</i>	Ellipsoidal	Smooth	(21.5-24.5) × (15.5-17.5)	Yes	Yes	ND	Yes	No	Arnastauskiene et al. , 1978
<i>E. muris</i>	Ovoid	Smooth	21.0 ×15.0	No	No	9 ×6	Yes	No	Pell édy , 1974
<i>E. naye</i>	Cylindrial	ND	(18.0-21.0) × (12.0-13.0)	No	No	6 ×6	Yes	ND	Pell édy , 1974
<i>E. nereensis</i>	Ellipsoidal	Rough	29.5 ×26.7	No	No	15.7 ×12.6	Yes	Yes	Glebezdin , 1973
<i>E. rugosa</i>	Piriform	Smooth	24 ×16	Yes	No	16 ×10	Yes	ND	Pell édy , 1974
<i>E. russiensis</i>	Spherical	Smooth	21.7 ×21.7	No	Yes	8.7 ×8.6	No	ND	Levine & Ivens , 1965
<i>E. svanbaevi</i>	Ovoid	Smooth	24.9 ×20.5	No	Yes	10.3 ×7.7	No	ND	Levine & Ivens , 1965
<i>E. sylvatica</i>	Ellipsoidal	Rough	18.5 ×14.0	No	Yes	11.2 ×7.6	Yes	Yes	Levine & Ivens , 1990
<i>E. uptoni</i>	Subspherical	Smooth	14.4 ×12.3	No	Yes	8.2 ×5.2	Yes	Yes	Lewis & Ball , 1983
<i>E. zaurica</i>	Ellipsoidal	Smooth	23.1 ×21.0	Yes	Yes	9.0 ×7.0	Yes	No	Musaev & Veisov , 1965
<i>E. zuhairamri</i>	Broadly ellipsoidal	Rough	29.6 ×23.3	Yes	No	15.9 ×9.2	Yes	Yes	Hürkov á et al. , 2005

Lists of species and synonymy adopted from Higgs and Nowell (1991) , Hürkov á et al. (2005) , ND = no data.

Eimeria chevrieri sp. nov. has ellipsoidal oocysts with a single-layered , colorless , smooth wall. There are three other species of *Eimeria* in *Apodemus* with ellipsoidal shaped oocysts and a single-layered smooth wall: *E. gomurica* Musaev and Veisov , 1963 , *E. kaunensis* Arnastauskiene et al. , 1978 and *E. gandobica* Musaev and Veisov , 1965. *E. gomurica* and *E. kaunensis* differ by the presence of oocyst residuum and larger oocysts (Levine and Ivens , 1990). *E. gandobica* is the most similar to *E. chevrieri* sp. nov. , however *E. gandobica* has broadly ellipsoidal shaped oocysts and significantly smaller size of oocysts and sporocysts (19.0 ×16.8 vs. 21.2 ×16.3 ; 8.0 ×5.0 vs. 11.2 ×7.5) , a small-granular sporocysts residuum and absence of sub-stieda body and sporozoite refractile body. *E. alorani* Hürkov á et al. , 2005 , *E. apodemi* Pell édy , 1974 and *E. zaurica* Musaev and Veisov , 1965 also have ellipsoidal oocysts with smooth but bilayered wall. Moreover , in contrast to

E. chevrieri sp. nov. , *E. zaurica* has oocyst residuum. *E. alorani* has significantly larger oocysts (26.9 ×19.3 vs. 21.2 ×16.3) , and sporocyst residuum forms a globular cluster about 4-5 in diameter. *E. apodemi* oocysts are broadly ellipsoidal , often asymmetrical , no polar body and stieda body.

Another species of *Eimeria* found in *A. chevrieri* is identified as *E. hungaryensis* by its oocyst size , oocyst shape and rough cyst wall. *E. hungaryensis* Levine & Ivens , 1965 was originally described as a new species of coccidium infecting *A. flavicollis* from Hungary. Then it was reported in *A. sylvaticus* and *A. flavicollis* in the British Isles (Lewis and Ball 1983) , in *A. argenteus* and *A. speciosus* in Japan (Synonym *E. montgomeryae*) (Wash et al. , 1985 ; Higgs and Nowell , 1991) , and repeatedly in *A. flavicollis* from Lithuania (Griekieien é , 2005) .

The genus *Apodemus* includes fourteen species.

While much morphologic, genetic and distributive informations are known about many of these species, only seven species (*A. agrarius* Pallas, 1771; *A. flavicollis* Melchior, 1834; *A. sylvaticus* Linnaeus, 1758; *A. argenteus* Temminck, 1843; *A. speciosus* Temminck, 1758; *A. mystacinus* Danford and Alston, 1877; *A. chevrieri* M-Edwards, 1868) have been surveyed for coccidia. The incidence of infection by *Eimeria* (29%, this study) suggests a possibility for the discovery of additional coccidian species if more host species are examined.

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高原姬鼠—新艾美球虫记述 (顶复合门, 艾美球虫科)

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摘 要 粪检云南省昆明市太平镇捕获的 31 只高原姬鼠 *Apodemus chevrieri*, 在 9 只高原姬鼠中共发现了 2 种艾美球虫, 自然感染率为 29%, 其中 1 种被命名为新种: 齐氏艾美球虫 *Eimeria chevrieri* sp. nov.。齐氏艾美球虫孢子化的卵囊椭圆形, 大小为 $21.2\ \mu\text{m} \times 16.3\ \mu\text{m}$ ($22.2 \sim 19.7\ \mu\text{m} \times 17.3 \sim 15.6\ \mu\text{m}$)。卵囊壁光滑, 单层, 厚约 $1.0\ \mu\text{m}$; 无胚孔和卵囊余体。有 1~2 个极体, 极体形状不规则, 直径 $1.0 \sim 2.0\ \mu\text{m}$ 。卵圆形的孢子囊大小为 $11.2\ \mu\text{m} \times 7.5\ \mu\text{m}$ ($12.3 \sim 10.3\ \mu\text{m} \times 8.3 \sim 6.8\ \mu\text{m}$), 有孢子囊余体, 且主要分布在 2 个子孢子的中间, 斯氏体扁豆形, 大小为 $1.0\ \mu\text{m} \times 0.3\ \mu\text{m}$, 亚斯氏体亚球形, 大小为 $2.5\ \mu\text{m} \times 1.5\ \mu\text{m}$ 。子孢子在孢子囊里面头尾相接, 在其宽端有 1 个明显的反光体, 直径约 $3\ \mu\text{m}$ 。模式标本保存在云南大学标本馆。

齐氏艾美球虫, 新种 *Eimeria chevrieri* sp. nov. (图 1~2, 4)

寄生于姬鼠属, 具有椭圆形的卵囊, 卵囊壁具有光滑、无色、单层特点的艾美球虫有 3 种: *E. gomurica* Musaev and Veisov, 1963, *E. kaunensis* Arnastauskiene et al., 1978 和 *E. gandobica* Musaev and Veisov, 1965。 *E. gomurica*、*E. kaunensis* 与本种的主要区别是卵囊较小且有卵囊余体; *E. gandobica* 与

本种的主要区别是卵囊呈宽椭圆形, 卵囊和孢子囊较小 ($19.0\ \mu\text{m} \times 16.8\ \mu\text{m}$ vs. $21.2\ \mu\text{m} \times 16.3\ \mu\text{m}$; $8.0\ \mu\text{m} \times 5.0\ \mu\text{m}$ vs. $11.2\ \mu\text{m} \times 7.5\ \mu\text{m}$), 孢子囊余体少, 无反光体和亚斯氏体。

寄生于姬鼠属, 具有椭圆形的卵囊, 卵囊壁具有光滑、2 层特点的艾美球虫有 3 种: *E. alorani* Hůrkov Ā et al., 2005、*E. apodemi* Pellérdy 1974 和 *E. zaurica* Musaev and Veisov, 1965。 *E. zaurica* 与本种的主要区别是具有卵囊余体; *E. alorani* 的卵囊和孢子囊比本种大的多 ($26.9\ \mu\text{m} \times 19.3\ \mu\text{m}$ vs. $21.2\ \mu\text{m} \times 16.3\ \mu\text{m}$), 且其孢子囊余体形成一个直径约 $4 \sim 5\ \mu\text{m}$ 的球状结构; *E. apodemi* 的孢子化卵囊呈宽椭圆形, 经常不对称, 无极体和斯氏体。该种区别其它种的关键特征是: 1) 孢子化卵囊椭圆形, 卵囊壁光滑、单层、无色; 2) 有极体; 3) 孢子囊有亚斯氏体。

模式标本, 含孢子化卵囊的齐氏姬鼠粪便保存在云南大学生物系, 标本编号: 2006047; 齐氏姬鼠标本保存于云南大学标本馆, 标本编号 20060081。

词源: 种名源自宿主种名。

关键词 高原姬鼠, 艾美球虫, 新种, 中国.

中图分类号 Q959.11